

A QUANTITATIVE CONTENT ANALYSIS OF  
ERRORS AND INACCURACIES IN MISSOURI  
NEWSPAPER INFORMATION GRAPHICS

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A Thesis presented to the Faculty of the Graduate School  
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Master of Arts

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by

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A QUANTITATIVE CONTENT ANALYSIS OF  
ERRORS AND INACCURACIES IN MISSOURI  
NEWSPAPER INFORMATION GRAPHICS

Presented by Seth Myers

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And hereby certify that in their opinion it is worthy of acceptance.

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## DEDICATION

This is dedicated to my family.

## ACKNOWLEDGEMENTS

I would like to thank my thesis committee for their knowledge and advice, the Missouri Press Association for their assistance with my research, and Lulu Rodriguez, whom I have never met and probably never will, for conducting the original research this study replicates.

Special thanks goes to two journalists, Professor Robert Unger of UMKC and my friend Matt Schofield of the Kansas City Star, whose advice and suggestions helped me develop this research.

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A QUANTITATIVE CONTENT ANALYSIS OF  
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ABSTRACT

This quantitative content analysis examined a total of 143 infographics in 201 issues of 42 daily newspapers. Of the 143 infographics examined, 57 errors were identified. The study concludes the overwhelming majority of infographics were published by just three of the 42 daily newspapers. Interestingly, the research shows errors are more likely to occur in simpler rather than more complex infographics. The data also suggest that, although maps are the most common type printed in newspapers, graphic artists lack some basic map-making skills. The most common type of error found was the omission of a north arrow or mile-marker in a map.

## CHAPTER ONE

### INTRODUCTION

An infographic is a communication tool that can clarify the chaotic, uncover the unknown, and enlighten the confused. It is a combination of words and images that synthesize the often mutually exclusive worlds of art and science. These displays are important to print journalism because they can facilitate the comprehension of complex ideas and events. Infographics can communicate large amounts of data to readers quickly and easily, enabling them to learn about their world by making comparisons and drawing distinctions among separate sets of information (Macdonald-Ross, 1977). According to Neurath (1939), a pioneer in ISOTYPEs, comparisons are the basis for all visual communications.

This paper is a replication of a study presented by Lulu Rodriguez in 1998 to the Visual Communication Division of the Association for Education in Journalism and Mass Communication. Her paper is titled *Errors and Inaccuracies in Iowa's Local Newspaper Information Graphics*. In that study Rodriguez stated, "Examining the data and design of info-graphics in depth is important because decisions that lead to publishing a chart have an impact on individuals and social groups" (p. 3). Decisions leading to the publication of a chart affect what information the chart shows and what kind of story it tells. The information reported by newspapers helps people form opinions about themselves and the world. It is important to understand how and why decisions that affect our society are

made. This study measures the increasing pervasiveness of graphics in Missouri newspapers and the number of errors they contain. Understanding this data is an initial step towards the improvement of news dissemination, which can ultimately result in heightening readers' awareness of the world. My goal is to present Missouri newspaper editors with tangible data on the accuracy of their graphics and comparative data on their competitors in the state.

Rodriguez (1998) showed that the most common errors made in Iowa newspaper graphics were due to simple oversights. She called these obvious mistakes "violations of convention." This category includes missing headlines, attributions, or mile markers on maps. Rodriguez also determined that the most common type of graphic produced in Iowa was a map, accounting for some 106 out of the 187 graphics found. Rodriguez discovered graphics produced externally were just as likely to contain errors as ones produced in-house. Comparisons will be made between her study and this one to look for similarities. Holsti (1969) said this gives the study a higher level of concurrent validity. Additionally, I am interested in learning whether there is an association between a newspaper's financial resources and the quality and number of infographics it prints. This interest is based on an economic theory proposed by McManus (1990) that suggests that within a news organization there is a potential conflict between the goals of making money and providing information to the public.

Chapter Two reviews the history of infographics and their place in the disciplines of history, science, philosophy, and journalism. It then examines three related prongs of research relevant to this study: how effective graphics are in communicating information; what role they should and do play in newspapers; and what standards can be used to

assess their quality (Utt & Pasternack, 2000). It concludes by explaining the theoretical framework and relevant literature on the economic and social theories supporting the research questions. Chapter Three outlines the study's methodology. Chapter Four starts with a presentation and discussion of the results, closing with an analysis of the study's possible limitations and suggestions for future research.

This is a quantitative content analysis of a week's worth of 42 daily newspapers in Missouri, and includes every newspaper received by the Missouri Press Association from December 10 through 14 and on December 17, 2007. Each infographic was analyzed and categorized based on nine pre-determined variables: the number of graphics associated with a story; the format of the graphic; the geographic scope of the topic discussed; the general category of the topic discussed; the source of the graphic; errors spotted in the chart; the number of variables presented; whether the graphic was accompanied by separate text; and the size of the newspaper.

## CHAPTER TWO

### LITERATURE REVIEW

This chapter defines infographics, looks at examples of good and bad ones, and then briefly recaps their place in the disciplines of history, science, philosophy, and journalism. Next, I review the study being replicated, as well as the theoretical framework and applicable economic theory.

#### **Background**

In 2005 Alberto Cairo, a professor of journalism at the University of North Carolina at Chapel Hill, wrote, “Newspaper graphics are the craft of telling news stories using the tools of information design, illustration, cartography and/or photography. Nowadays you can add video, audio and interactivity” (Cairo, 2005, p.12). Previously, in 1983 Edward Tufte had provided a simpler definition that is used in this study: an infographic is a visual representation of quantitative information.

#### *History*

The use of infographics is not a new phenomenon. In fact, people have used non-linguistic means to tell stories for millennia, dating back at least 8,200 years. Friendly (2001) said the earliest known map, of Konya, Turkey, was created around 6200 B.C.

Some of the world's most notable scientific discoveries involved drawings designed by inventors to help them understand and explain complicated ideas. As shown in Figure 1, Nicholas Copernicus sketched his Heliocentric Theory, that the sun is the center of the universe, to help explain that concept, ushering in the scientific revolution in 1514. Johannes Kepler used drawings to prove his three laws of planetary motion. Wainer (1997) said the list could continue, to include Galileo, Descartes, and Vinci.

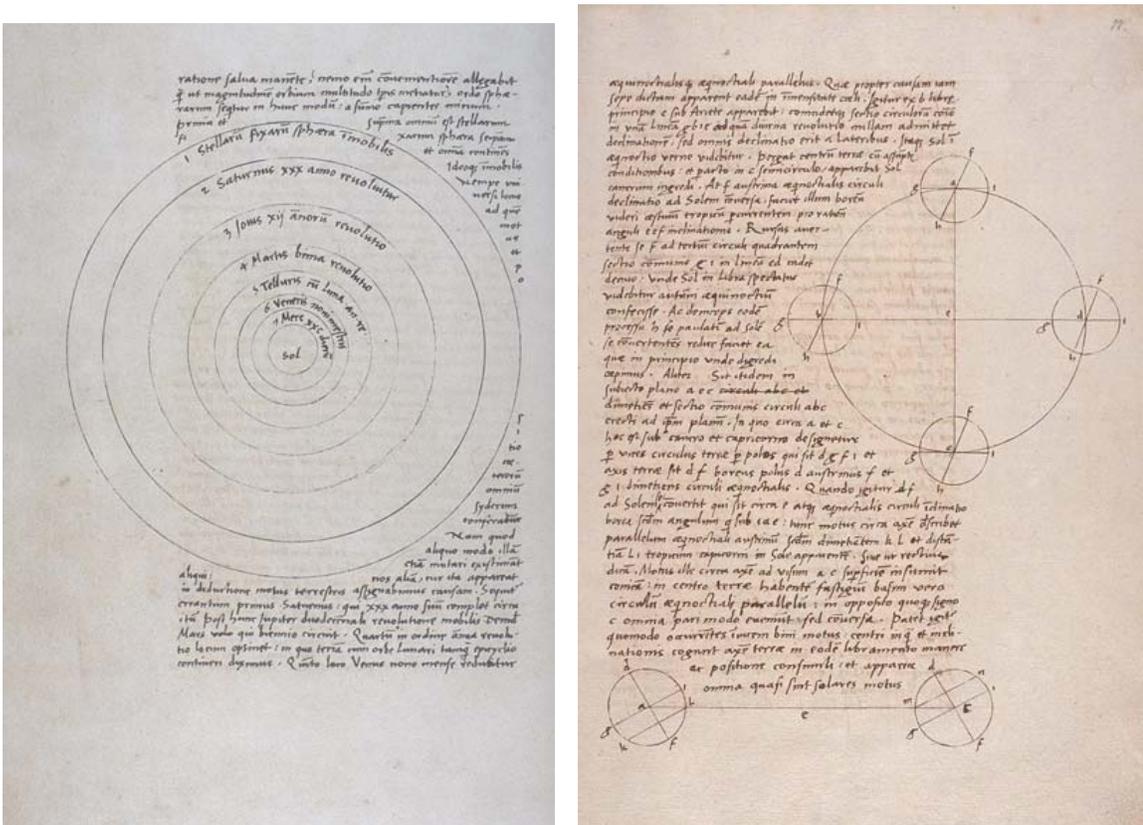


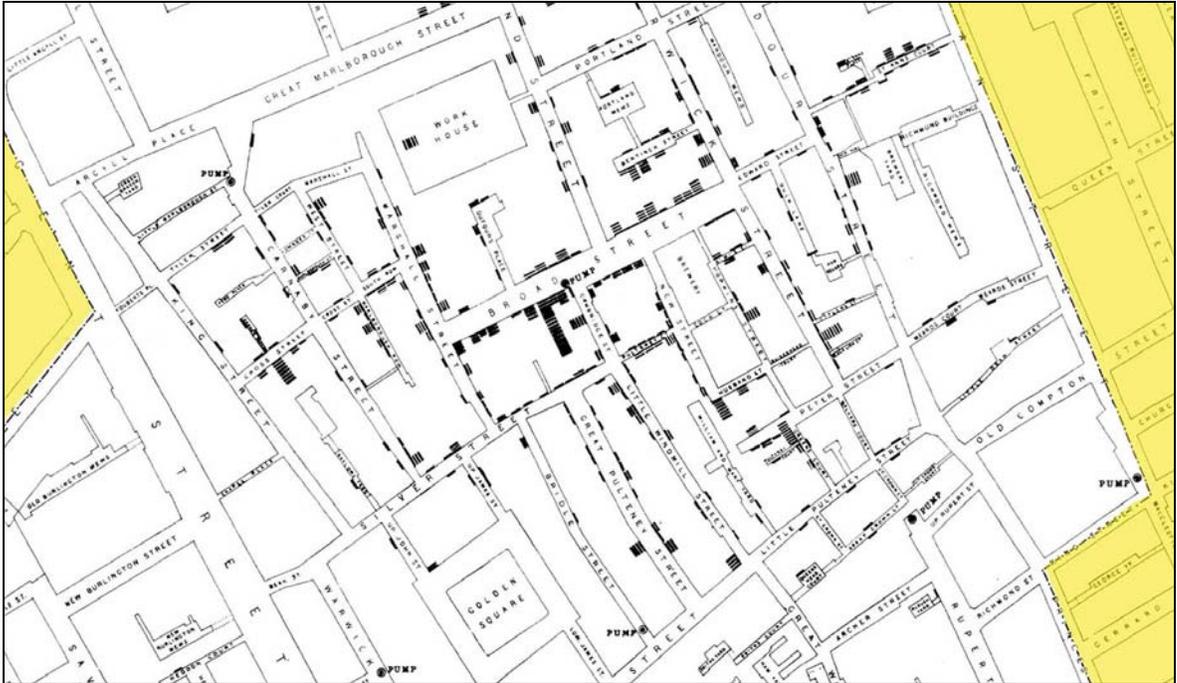
Figure 1. Sketches by Nicholas Copernicus explaining his Heliocentric Theory, from *De revolutionibus*. Retrieved on August 8, 2008 from [http://www.bj.uj.edu.pl/bjmanus/revol/titlpg\\_e.html](http://www.bj.uj.edu.pl/bjmanus/revol/titlpg_e.html).

Data-based graphics emerged in earnest in the mid-seventeenth century, but their current popularity can be traced back to one event, the publication of the *Commercial and Political Atlas* by William Playfair in 1786 (as cited by Wainer, 2005, p. 12). Playfair's book described the imports and exports of England and Wales and he created many of the graphical forms used today. Cairo (2005) suggested this atlas also helped create a new sub-discipline called information design.

### *Excellent Information Design*

The three infographics shown in Figures 2, 3, and 4 are commonly mentioned as examples of outstanding infographics by experts like Tufte, Wainer, Cairo, and Stovall. These examples are outstanding because they all simplify large amounts of data to tell an important story clearly and concisely.

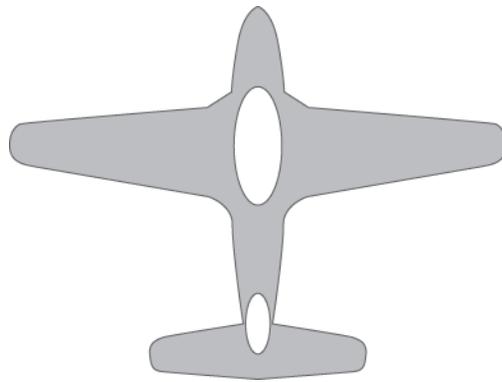
In 1854 Dr. John Snow investigated a cholera outbreak that killed about 500 people in central London. By plotting the deaths on a map, shown in Figure 2, he was able to connect the outbreak to a specific contaminated water pump and its connections. Wainer (1992, p. 14) said the epidemic ended within days after the pump was removed.



*Figure 2.* Map created by Dr. John Snow of a deadly cholera outbreak in London. From *On the Mode of Communication of Cholera*, by John Snow, 1854, London, C.F. Cheffins. Retrieved on August 8, 2008 from <http://www.ph.ucla.edu/snow/>.

Abraham Wald tracked bullet patterns on planes returning from battle during World War II. Through mapping and deductive reasoning he was able to determine where to place additional armor for the greatest protection (Wainer, 1992, p. 15). Figure 3 shows the blank areas where planes returning from battle had no bullet holes. This is where Wald recommended adding armor. He correctly assumed the planes that showed bullet holes in these areas did not return from battle.

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*Figure 3.* Abraham Wald tracked bullet patterns on planes returning from battle in World War II. The blank areas are where there were no bullet holes, and extra armor was added.

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Charles Minard mapped the tragic 1812 march of Napoleon’s army into Russia.

He successfully told this narrative by graphing the depleting French Army’s size, the troop movements, and the chilling temperatures. Tufte said, “It may well be the best statistical graphic ever drawn” (1983, p. 40).

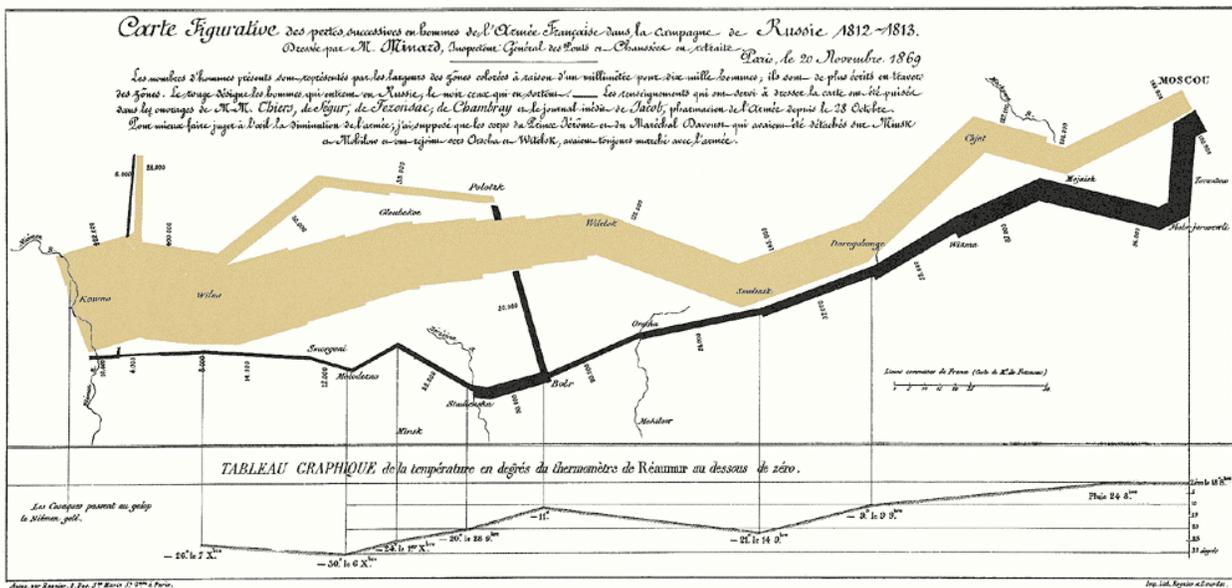
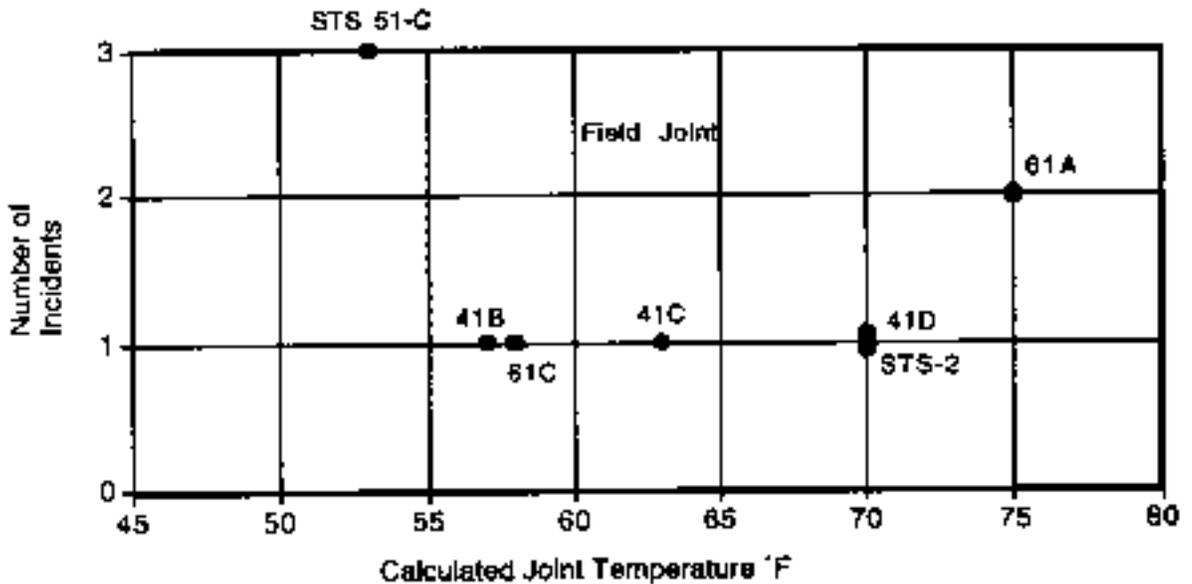


Figure 4. Charles Minard’s map of Napoleon’s 1812 campaign into Russia. From Tufte (1983).

*Failure of Information Design*

In contrast, Figure 5 may be the worst infographic ever made, according to Tufte and Wainer. There are many examples that could fit in this “worst” category, but a significant tragedy resulted from the mistakes made in this chart.

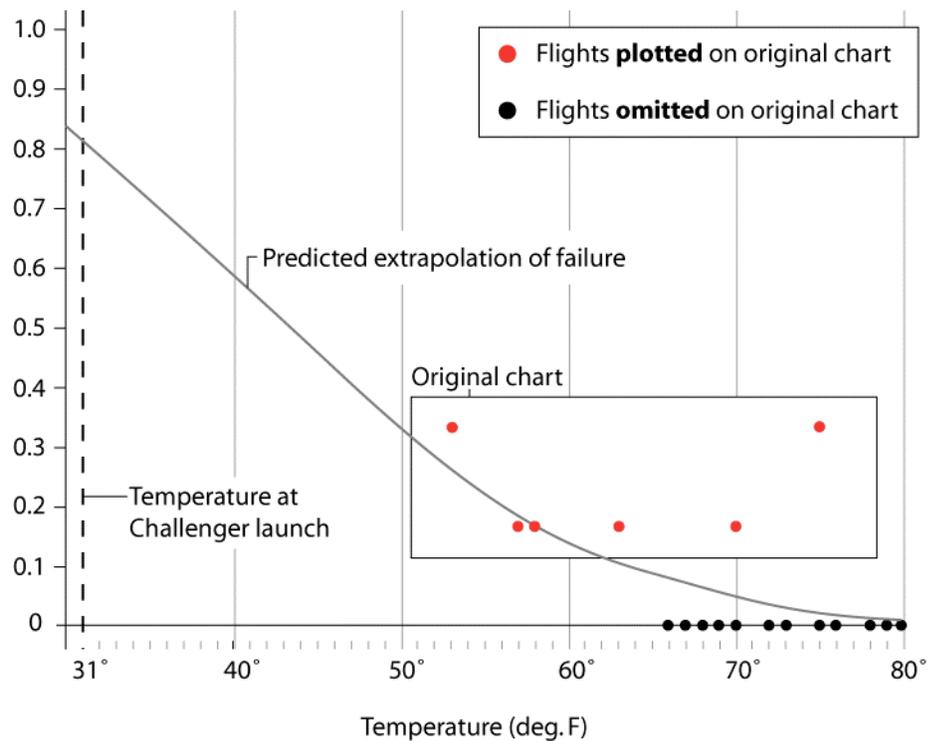


*Figure 5.* This is an inaccurate chart of space shuttle O-ring performance viewed by NASA officials the night before the Challenger disaster. From the *Report of the Presidential Commission on the Space Shuttle Challenger Accident*, 1986, 1, p. 145.

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The absence of data from a chart on cold-weather O-ring performance led to the explosion of the space shuttle Challenger that killed the seven astronauts on board. The above chart was shown to NASA scientists on January 27, 1986, the night before the accident. Each data point represents a shuttle flight that experienced thermal distress on particular O-rings in the solid rocket motor. An analysis of the disaster (Dalal, Fowlkes,

& Hoadley, 1989) said that based on the above chart, decision-makers mistakenly concluded there was no historical data on the performance of O-rings in cold weather, ultimately deciding to go ahead with the launch. Unfortunately, whoever made this chart omitted all the shuttle flights where no thermal distress of the O-ring occurred. If the chart had included these numbers, the disaster possibly could have been prevented.



*Figure 6.* This is a corrected chart of space shuttle O-ring performance, including flights that experienced no problems. The predicted extrapolation for a flight at 31° is included. (Image refigured for clarity.)

Figure 6 is the same chart as Figure 5, with the zero-failure data inserted and a logistic regression model fitted to examine the probability of failure at 31°, created by the Statistics Department of York University in England. The predicted extrapolation of the

previous tests show a probability of over 80% that the Challenger's O-ring would fail on the launch day.

The Challenger disaster demonstrates the power of infographics as a form of communication. A review of relevant texts in epistemology, education, and cognitive psychology help explain where this power comes from.

### *Why infographics?*

Albert Einstein explains how he used visualizations to help him understand difficult concepts:

The words or language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which serve as elements in thought are certain signs and more or less clear images which can be voluntarily reproduced or combined....The above mentioned elements are, in my case, of visual and some muscular type. (as cited by Cairo, 2005, p. 14)

The justification for the use of infographics is at the center of a long-standing debate over mental imagery and, more broadly, the nature of knowledge. The brain's use of imagery to recall and process ideas is central to the nature of thought. Aristotle claimed it is impossible to think without the use of mental pictures.

Contemporary researchers have advanced Aristotle's idea of mental imagery to be understood as an active psychological process instead of an object to be viewed by the mind's eye. Allan Paivio presented the Dual-Coding Theory in 1974, which helps explain a large body of research demonstrating that people learn better when images and text are combined (as cited in Kulhavy, Stock, Woodward, & Haygood, 1993).

Paivio's dual-coding theory argues, "Verbal and nonverbal information is represented and processed in distinct but interconnected symbolic systems." The theory suggests text and images work synergistically in the mind, thereby increasing the level of comprehension provided by either method independently.

If people tend to process ideas as images, it is reasonable to assume that an idea can't truly be understood unless it can be visualized. If this is true, the combination of text and visuals in infographics provide readers an easier avenue toward comprehension.

### **Newspaper Infographics**

The visual representation of information is not a new phenomenon in the journalism industry either. One of the earliest newspaper infographics is a map of the Bay of Cadiz printed in the *Daily Courant* (England) in 1702.

Although infographics are nothing new to the industry, they have experienced a surge in popularity over the last few decades (Utt & Pasternack, 1993, 2000). The total number printed dramatically increased from 1982 to 1995. Then, the quantity started to drop off slightly in the following years, but Utt and Pasternack (2000) said the reduction related to an increase in quality, not a lack in popularity. In line with their explanation, recent researchers have begun to turn their focus from the number of infographics produced to the more fundamental issue of their effectiveness. The central focus is now a question of quality, not quantity.

Pioneering researchers in infographic quality created blanket hypotheses that were difficult to test; for example, that bar charts are more effective than line charts. Studies by Peterson and Schramm (1954), Croxton and Stryker (1927), and Croxton and Stein

(1932) illustrate a few examples of this era's confusing findings. A common controversy was whether a bar chart or pie chart was better at conveying information. Wilcox (1964, p. 38) explains that this line of thought failed to account for outside factors that contribute to the quality of a graphic, such as the type of information being displayed.

Along the same line of thought, Vessey's (1991) Cognitive-Fit Theory explained that a major flaw in early research was its attempt to compare the intrinsic value of each chart. She argues that each form of chart or table supports a specific type of information. How well a graph or table performed in these early experiments depended on what type of information was being presented. A study by Simkin and Hastie (1987) makes a similar conclusion that bar charts are good for making comparisons and pie charts are good for judging percentage. Macdonald (1977, p. 64) sums up the issue well: "Any graphic format can be executed well, or poorly, for a particular purpose. This is often a more significant variable than the choice of format."

*USA Today* was first published on September 15, 1982. Utt and Pasternack (1993) argued that this marked the advent of major changes throughout the industry, especially in the use and study of graphics. A bandwagon effect created by the success of *USA Today* fueled this change. Researchers began studying graphics in earnest as the proliferation of visual displays of information became more pronounced.

In the late 1980s Hartman (1987) predicted this new style would save a dying industry. Young readership was declining, but his study of 321 people aged 18 to 35 suggested this trend could be reversed if more newspapers adopted *USA Today's* format.

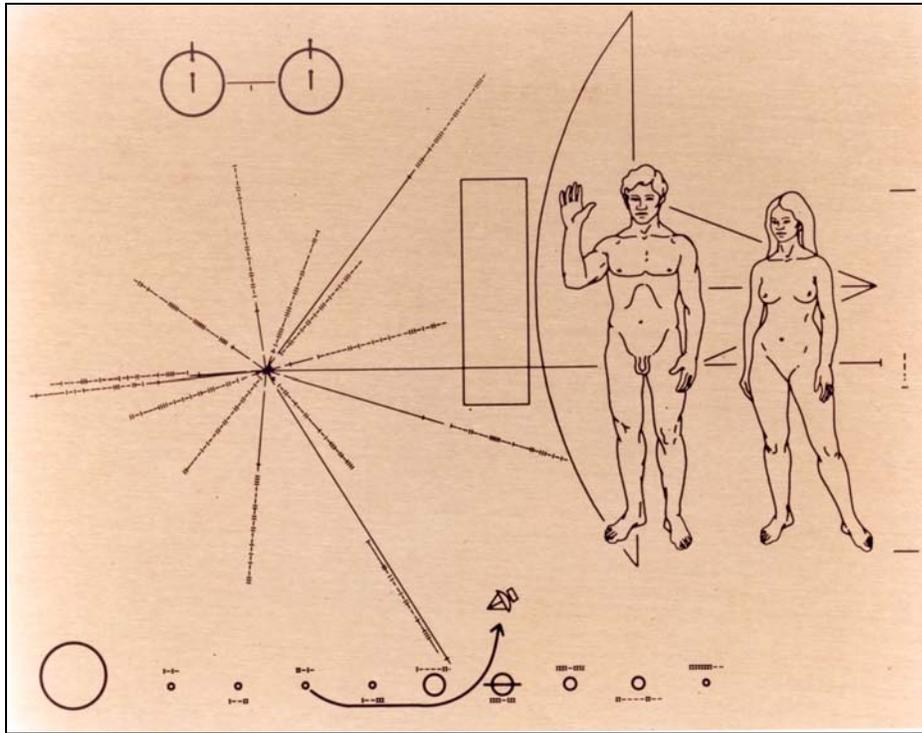
Larger photos, additional color, and more infographics in American newspapers caused a reduction in the number of front-page stories. From 1965 to 1985, the average

number of these stories dropped from 13 to 6 (APME, 1985) In a similar study of 114 daily newspapers, Kenney and Lacy (1987, p. 37) found that in 1987 infographics already occupied an average 27% of front pages. These studies indicate the rising popularity of this new newspaper design.

In the late 1980s and early 1990s, a more specific research focus began to emerge, with three related prongs of research relative to this study: how effective graphics are at communicating information; what role they play in newspapers; and what standards can be used to assess their quality (Utt & Pasternack, 2000). These lines of research play a central role in the evaluation of infographics. Each will be briefly examined to provide a theoretical base for the standards used in this study to assess each infographic's errors.

### *How Effective are Graphics?*

This section explains what the term “effective” means in this study’s context. The evaluation of any communication process, as described by Shannon’s Information Theory (1948), is dependent on at least two factors: the sender and the receiver.



*Figure 7.* This is a plaque attached to Pioneer 10, the first spacecraft to leave the solar system. It is intended to communicate basic information on the spacecraft's origin to its finder. Retrieved on March, 2008 from <http://www.nasa.gov>.

This plaque exemplifies the importance of considering the entire communication process when evaluating effectiveness. It is attached to Pioneer 10, the first spacecraft to leave the solar system, and was designed in 1972 by Carl Sagan, Linda Salzman Sagan, and Frank Drake, of Cornell University. They said the plaque was intended to convey information about Pioneer 10's origin and its creators.

Under normal circumstances this plaque would be considered ineffective because it fails to communicate much. But when we consider it as a message to an unknown civilization describing mankind on Earth, an evaluation of the plaque's effectiveness

becomes impossible. We don't know anything about the intended receiver, and therefore have no idea whether the receiver will decode the message correctly. Cleveland (1993, p. 20) said, "A graphical method is successful only if the decoding process is effective. Informed decisions about how to encode data can be achieved only through an understanding of the visual decoding process."

Measuring effectiveness has produced varied results. In 1993, Ruel found readers' comprehension increased when a story was accompanied by an infographic. Two different versions of a story were printed in the *Columbia Missourian*. One contained text only and in the other, text was joined with a graphic. When the sample was controlled for the subjects who noticed the story, the cumulative comprehension scores were significantly higher for readers of the combined sample than for those reading the text-only version.

Another significant study by Andrews, Kees, Kozup, and Burton (2006) was conducted to determine the most effective form of cigarette warnings. The World Health Organization adopted a treaty requiring that information in the form of text, pictures, or both be printed over at least 30% of a cigarette pack. The researchers found that a combination of graphics and visuals with textual warning statements created the desired result of higher levels of fear and anxiety than just text alone. The overwhelming majority of researchers agree with Ruel and Andrews, et al. (1993), that infographics are effective at improving reader comprehension and recall, as well as attracting readers' attention, but there are some empirical studies that suggest the opposite.

Ward (1992, p. 320) cited Roller's discovery that text paired with a graph is harder than text only for early teens to understand. The age of the subjects (13 years)

could have been an uncontrolled variable in this outcome. Ramaprasad's study (1991, p. 92) found graphs only slightly increased reader recall, and incorrect graphs actually misled readers.

Another possible reason for these discrepancies is illustrated by applying the findings of Bertin and Francolini (1973). They found graphics supply three separate levels of answer sophistication. The elementary level involves data extraction, the intermediate level involves trends in sections of data, and the superior level examines the bigger picture of major trends and groupings (Francolini Wainer, 1980, p. 84). Comparing graphs produced at different levels of sophistication could influence the reader's level of comprehension.

Bertin and Francolini's superior sophistication level highlights the power of infographics as tools of information discovery as well as communication. Hutto (2007, p. 88) showed how engineers use graphics to stimulate their ideas when writing. This finding corresponds to my personal experience in the newsroom. I have found that when writers and graphic artists get together early in the story-creation process, new and more creative story ideas seem to be produced. Visualizing information helps the reporter make comparisons that might not have been made otherwise.

### *What Role Do Graphics Play?*

The second line of research focuses on the purpose of infographics in newspapers. Utt and Pasternack (2000) show that infographics have enjoyed increased popularity among journalists and readers since the mid and late 1980s, but their precise role is still unclear. Is the primary function to attract the reader's attention, like an illustration does,

or to convey information? The underlying conflict here is related to quality. If the purpose is to attract readers, artistry and flair should be basic tenets of graphic quality. If the purpose is to convey information, art for the sake of eye appeal may confuse or mislead readers and defeat the purpose. Today, the industry has decidedly become content-driven instead of appearance-driven, although graphics do play a dual role. Utter and Pasternack's (2000, p. 62) survey of graphic editors shows that some believe their primary purpose is illustrative, but the vast majority, 84.7%, believe that conveying information is the primary goal.

Berlyne (1958, p. 289) suggests that complex stimuli increase perceptual curiosity. Readers spend more time with a decorative graphic because their interest is piqued (Tankard, 1989, p. 92). It is reasonable to assume that the more time subjects spend reading a graphic, the more information they will process. Tankard (1989) argues that a graphic should draw a reader into a story with flair and creativity. He studied reader interest and information gain from "chartoons," a term for charts combined with cartoons. The results suggest readers find chartoons more interesting, but interest does not correspond to an increase in information gain.

Kelly (1989) disproves Edward Tufte's data-ink ratio formula (1983), which states superfluous ink should be omitted. The formula creates a mathematical equation to judge how much extra ink is in a graphic. Tufte also made recommendations for appropriate levels of data to ink. Kelly argued reader comprehension is not affected by extra ink, and claimed to have found Tufte's principle incorrect. Regardless of Kelly's findings, it is considered bad form to dress up charts. Tufte's idea is similar to Strunk and White's (1999) writing principle, that needless words should be avoided.

Three central theories were identified by Tankard (1989) to support the industry's primary focus on information over visual appeal.

Tufte (1983) developed the first theory. He took a minimalist approach to this issue in his book, *The Visual Display of Quantitative Information*. The data-ink ratio requires every drop of ink to be used to convey information. He said anything else is superfluous.

Another argument is a schema theory developed by Pinker in 1981, and applied to graphs by Simkin and Hastie (1987, p. 459). Our brains function like mental scaffolding on which to hang incoming information. Over-decorated or cartoonish charts emphasize a different schema that conflicts with the graphic schema. This conflict leads to confusion and lowered comprehension (Tankard, 1989, p. 94).

The third theory applies Gestalt psychology to print design and graphics. The principle of figure-ground separation states that a reader's perception of an image's focal point can be confused with the image's background, if there is not a clear separation between the two (Fitz Moore, 1993, p. 391). Tankard (1989) uses the famous Peter-Paul/goblet graphic as an example of this principle. A viewer can only see one Gestalt at a time, either the twin faces or a goblet. Over-decorated graphics could cause similar cognitive problems, especially if an image in the graphic is used as background as well as a representation of information.

### *Quality Standards to Assess Graphics*

The third area of research focuses on systems and theories used to determine the quality of infographics. While many experts can agree on which infographics are good or

bad, there is surprisingly little empirical research that definitively codifies standards of good or bad practices into a single overarching framework. The closest researchers have come to this is a study completed by Wainer (1990). He compiled three important unchanging aspects of graphical display by comparing certain postulates of Playfair and Tukey. They agreed on three pillars of data display: impact is important; understanding graphs is not always automatic; and a graph can easily show things that might otherwise have gone unseen. These time-tested postulates appear to be basic, but are foundational to the modern perception of graphic quality.

Math education researchers Curcio, Bright, and Friel (2001, p. 125) recently said, “Overall, no one has proposed a coherent framework that addresses the domain of graph comprehension.” While this is true, there is a vast amount of empirical evidence explaining specific discoveries. The problem is that there is no framework objectively holding together or connecting these discoveries. In order to evaluate infographics there must be some unified system on which to base the evaluations. Developing this system has been an interest of researchers in a variety of fields for almost a century, although a single universally accepted system has yet to emerge. The Committee on Standards for Graphic Presentation (1915, p. 91) acknowledged the importance of such a system almost a century ago:

If simple and convenient standards can be found and made generally known, there will be possible a more universal use of graphic methods with a consequent gain to mankind because of the greater speed and accuracy with which complex information may be imparted and interpreted.

The committee made 17 suggestions considered generally applicable to graphs. In 1977 Ehrenberg developed six basic rules in the creation of tables. That same year, Macdonald reported 10 conclusions concerning the effectiveness of graphs. A year later, Cox (1978) reported six suggestions to clarify the display of graphics. Frownfelter-Lohrke and Fulkerson (2001) compiled guidelines regulating accounting tables and charts, but these rules are not applicable to diagrams or maps. Wainer (1984) lists 12 of the most common mistakes that lead to reader confusion. Carl Jung's observation seems appropriate to this predicament: "To the scientific mind it is most annoying to have to deal with phenomena that cannot be formulated in a way that is satisfactory to intellect and logic" (as cited in Macdonald, 1977, p. 49).

While no one has developed an overarching system, researchers have woven together studies and knowledge from generations of practice and years of research to create a workable definition of what constitutes graphical errors. Unlike written or spoken communication, visual communication was not created with a set of rules. The rules governing visual communication are actually widely accepted social norms (Simkin Hastie, 1987). Communicating through pictures is one of the oldest ways to impart information. The Chauvet Cave drawings in southern France of mammoths, rhinos, and lions are estimated to be 32,000 years old. Archeologists have found evidence (Balter, 1999) that the cave artists were teaching apprentices how to draw. This suggests that even the earliest forms of visual communication were based on a set of standards, though the standards used by Pleistocene Epoch cave artists would probably not pass muster today. Therefore, the standards of visual communication have evolved along with culture and societies. This suggests it might not be possible to find a truly objective and enduring

standard. For this reason, accepted social standards, like expert opinion, must be considered when evaluating visual communications.

Macdonald-Ross (1977, p. 64) concluded, “In general, the advice given by expert [graphic] designers has been vindicated by subsequent empirical tests.” Yet, typical to this field, there can be no concrete rules, only guidelines. Towards the end of *Visual Display of Quantitative Information*, Tufte (1983, p. 191) said, “These principles should not be applied rigidly or in a peevish spirit; they are not mathematically or logically certain; and it is better to violate any principle than to place graceless or inelegant marks on paper.” This statement smacks of a disclaimer. It marks a shift in the book’s tone, and second-guesses principles that had been confidently explained

Over the years experts have honed a popular model for evaluating graphic quality. Expert opinions tend to focus on qualities that make a graphic good, instead of those that make it bad. Researchers focus on error because it is easier to quantify. Tufte (1983) gives four principles of graphic excellence that are generally summed up in one line: “Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest place.” Moen (2000) and Stovall (1997) also describe common errors based on assertions from research and theories already explained in this literature review.

Reflective of Stovall’s textbook, Rodriguez (1998) identified six types of common errors, which accurately compile the biggest problems most prevalent in modern graphics: violations of conventions; percentages without a base; comparing the non-comparable; inappropriate graphic; overdressed graphs; and non-correspondence with text. Violations of convention are mistakes that drastically confuse or mislead the reader.

Examples are omitting legends, “North” arrow indicators, introductory text, or attributions. This category also includes designs that produce an optical illusion of vibrations or movements. Percentage without a base refers to failing to supply a rate needed for comparison. An example would be comparing murders in Los Angeles with those in Kansas City. Los Angeles will likely have many more murders because more people live there. Comparing the non-comparable is comparing figures that are not derived from the same base. A common mistake in this category is failing to adjust for inflation when comparing cost over a period of time. Inappropriate graphic refers to using the wrong type of graphic to present a certain type of information. For example, bar charts compare relationships between numbers, whereas tables show specific data points that are not directly related. It is incorrect to use a bar chart to show data points that are unrelated. An example of an overdressed graph is one in which ink is used for decoration and doesn’t add to the information. Non-correspondence with text occurs when a graph’s information conflicts with information in the headline or chatter.

It is important to ask why these errors are consistently made. Stovall (1997) describes five common sources of error. Inaccurate information is one, and using bad sources is a major cause. Journalists’ errors cause many problems as well. These are technical errors that result from careless design and bad editing. The third and fourth sources of error are not understanding the information and not knowing how to properly use charts. Finally, not providing an adequate context for information can cause error. Without a comparison, data are just meaningless lists of numbers to the reading public. It is the job of the graphic journalist to frame information in a way that creates meaning.

## **Theoretical Framework**

This study examines common errors found in Missouri newspaper infographics, taking into account the potentially conflicting goals of making a profit while increasing public knowledge and understanding (McManus, 1990, p. 672).

## **Rodriguez's Research**

This study replicates as nearly as possible Rodriguez's paper, *Errors and Inaccuracies in Iowa's Local Newspaper Information Graphics*.

Davis (1995, p. 51) conducted a study similar to Rodriguez's, examining how Missouri newspaper editors viewed infographics. She concluded that they view them as "somewhat important." Davis also showed newspapers with a smaller circulation generally view graphics as being less important than do larger papers.

Rodriguez (1998, p. 26) concluded that the ability of Iowa newspapers to produce attractive graphics had outstripped their knowledge of how to design and use them well. "They are concerned more with the artistic and technical aspects of developing a graphic and not so much with its informational content." That is, these newspapers fell into the trap Tufte (1983, p. 91) warned of with his data-ink ratio: "Occasionally artfulness of design makes a graphic worthy of the Museum of Modern Art, but essentially statistical graphics are instruments to help people reason about quantitative information."

Rodriguez (1998, p. 27) also found the major reasons for the errors were designer oversights of basic conventions and ignorance of how to work with statistics.

More specifically, her research showed the most popular stories are on international, business, and infrastructure development topics. The locator map was the

most common type of graphic, followed by line graphs and bar charts. Violations of chart-making convention were the most frequent error. A violation of convention is an error that confuses or misleads the reader by not adhering to basic accepted norms, such as failing to include a map legend or omitting an attribution. Finally, she found the majority of charts originated in-house, but the error frequency was almost evenly split between infographics produced in-house and externally.

Rodriguez used a probability sample to review 187 infographics contained in 268 issues of 28 community newspapers. The 28 newspapers were randomly selected from 340 daily and weekly papers. Of the 28 selected, only two were considered dailies. The rest were published weekly or semi-weekly.

## **Theory**

The study of infographics is influenced by many disciplines, such as cognitive psychology, education, economics, accounting, and statistics. Analysis and opinions of experts, along with scholarly research, have shaped the way graphics are used in most academic and professional disciplines. The vast body of research on visual perception is pertinent to this study.

Macdonald-Ross (1977) provided a thorough analysis of the literature and empirical data supporting the commonly accepted theories of visual information processing. In *Perceptual Principles for the Design of Instructional Materials*, Fleming (1970) came to a fundamental conclusion that people do not readily perceive absolutes, but are adept at making comparisons and distinctions. These comparisons are made either between two sets of information presented side-by-side, or between new information and

old knowledge recalled from memory (Macdonald-Ross, 1977). These empirical findings are similar to Neurath's work with pictorial charts and the Isotype system (1939, p. 55). He argued, "All visual communication is based on comparisons." Although this statement was not based on empirical experiments, the independent agreement between the researcher and practitioner gives added weight to the argument.

A basic understanding of how the brain processes visual information is essential to the creation of excellent graphics. It is the graphic artist's task to present information in a form easily processed and understood by readers.

Current research evaluates graphics based on the function they perform. Macdonald-Ross (1977) stated that an important way humans learn about their world is by counting and comparing data sets. Infographics provide this function by making these comparisons clear and concise. The world is too big, with too many different conceptual frameworks, for readers to accurately compare actual quantities. Instead of overloading people with data, symbols are used to make the quantities and comparisons manageable. Like words and letters, graphics are simply symbols that represent ideas. It is the responsibility of journalists to provide an accurate representation of information conveyed, whether text or visuals. An important step in fulfilling this responsibility is to be alert to where mistakes can be made in the communication process.

### *Economic Theory*

To fulfill the responsibility of educating and informing, newspapers must first stay in business. Bagdikian (1989) remarked that news organizations are a "queer hybrid because they attempt to be both profitable businesses and public services." McManus

(1990) applied economic theory to test how news organizations manage the potential conflict between maximizing profits and increasing public knowledge.

McManus (1990, p. 673) said the model of professional news discovery states that media organizations have a responsibility to “actively and independently scrutinize their environments.” This is the type of reporting necessary to ensure the open and honest government envisioned by the framers of the Constitution. The traditional watchdog role of the media provides an important but expensive check on the government. The profit-maximizing model of “news discovery” views the news as a commodity that is bought and sold. In this sense, the production and dissemination of the news should follow an economic model. Given the scarce resources of time and capital, news organizations should “provide the least expensive mix of content that garners the largest audience advertisers want to reach” (McManus, 1990, p. 673). McManus argued that passive discovery of news is less expensive than active discovery. Passive discovery focuses on finding stories through press releases, emergency scanners, wire services, and other easily accessible news sources. Relying on these sources is not considered good journalism. Active discovery, which may require more reporters and more time per story, is more expensive but results in increased quality.

This conflict of interests could pose serious problems. A newspaper that passively discovers news is at best a re-packager of events. At worst, this could lead to a “manipulation of the public agenda by those elements of society powerful enough to subsidize discovery costs through public relations and promotions” (McManus, 1990, p. 674).

McManus (1990) examined three television news stations through both quantitative and qualitative means. The stations were categorized as extremely large, moderately large, and mid-sized. He found that the stations with greater resources were more likely to engage in active discovery of stories. McManus also discovered that every station, except the largest in certain circumstances, aligned with the profit-maximizing model. Some stations went so far as to repress story ideas that could reflect poorly on advertisers. These results are discouraging for the profession of journalism and the proper functioning of the government. Passive discovery surrenders control of the news to large corporations and powerful government interests. McManus argued that these organizations take advantage of the cost-conscious media to disseminate their own public relation efforts.

McManus failed to address an important economic principle found in contract theory. Active journalism might be more costly in the short term, but it could be beneficial in the long run. Hardt (1999) argued that a news agency's reputation, or the quality of its product, affects sales over a period of time. He explained this principle through the critique of a book on public journalism:

The book challenges the growing detachment of journalists at a time when the economic goals of the press to achieve production at the lowest possible cost constitute a formidable obstacle to the kind of journalism that celebrates community by practicing journalism. (1999, p. 198)

The argument for public journalism is based on the idea that improving the news media's product will increase sales, as well as benefit a democratic society (Hardt, 1999).

These economic theories suggest that a news station's income has an effect on its news content. Smaller stations with less money will use cheaper avenues to find content.

The same is true for newspapers. I'm using these economic theories to explain why smaller newspapers, with less financial resources, are more likely to use wire services and to produce graphics with errors. Based on these theories, the cost of hiring a trained graphic artist would drive smaller newspapers to heavily rely on wire services or untrained personnel to create their infographics.

### **Assumptions**

Two assumptions were made to conduct this study. First, a paper's circulation size is representative of its financial resources. The newspapers were divided by circulation size into three categories, representative of different levels of financial resources. Both McManus (1990, p. 676) and Rodriguez (1998, p. 9) made the same assumption: that larger newspapers have larger budgets. The second assumption is that more active means of news discovery are more expensive, primarily in terms of staff time. It takes graphic artists more time to create original graphics, which costs the newspapers more money.

## **Research Questions**

Eight research questions were proposed.

1. Do smaller newspapers publish more wire-service graphics than in-house graphics, and do larger newspapers publish more in-house graphics than wire-service graphics?
2. Do smaller newspapers' in-house graphics contain more errors than larger newspapers' in-house graphics?
3. What topics are most commonly addressed in graphics?
4. What types of graphics are used to depict these topics?
5. What are the most common types of errors?
6. Are graphics more commonly used in local, national, or international stories?
7. What is the frequency of mistakes in internally versus externally produced graphics?
8. Does complexity have an effect on a graphic's accuracy?

## CHAPTER THREE

### METHODOLOGY

Chapter Three begins with an overview of content analysis, followed by detailed explanations of the sampling design and inter-coder reliability test.

#### **Content Analysis**

This study employed a quantitative content analysis to examine errors made in Missouri newspaper infographics. Specifically, it focused on how a newspaper's financial resources affect the infographics it publishes. Budd, Thorp, and Donohew (1967) say more research is needed on the environmental factors that influence journalists' behavior, which in turn influences the creation of news content. The environmental factor in this case is the newspaper's financial resources.

Definitions of content analysis have varied greatly among researchers. A broad, all-encompassing view like Stempel's (1981) said content analysis was "A formal system for doing something that we all do informally rather frequently, drawing conclusions from observations of content." Riffe and Fico's (1998) narrower definition is used for the purpose of this study:

Quantitative content analysis is the systematic and replicable examination of symbols of communication, which have been assigned numeric values according to valid measurement rules, and the analysis of relationships involving those values using statistical methods, in order to describe the

communication, draw inferences about its meaning, or infer from the communication to its context, both of production and consumption. (p.44)

The forms of analysis are both written and visual, encompassing both aspects of a graphic. Riffe and Fico (1998) warn that visual communications can pose special problems because of ambiguities that are not clearly resolved within the message. This problem is avoided by viewing each aspect of the graphic, textual and visual, as part of a whole intended to send one message. The combination of text and image should provide more clarity than either would alone.

A graphic is defined as any visual representation of data (Rodriguez, 1998, p. 8). The unit of analysis measured is any graphic, whether accompanying a story or freestanding. The graphics examined here are line graphs, bar charts, pie charts, tables, maps (locator or data), and diagrams. Excluded from this analysis are weather maps, schedules of sports games, and stock market indicators, where these are regular parts of specific newspaper sections.

### **Sampling Design**

I spent a week at the Missouri Press Association reviewing and collecting every issue of every daily newspaper they received from December 10 through 14 and on December 17, 2007. The sampling frame includes only the issues received by the Press Association during my time there. Each morning the association organized and examined the newspapers received via mail. I was then allowed access to the newspapers before they were picked up by a clipping agency in the afternoon.

The type of non-probability sampling used here is considered to be a convenience sample. Riffe and Fico (1998) explain convenience sampling is appropriate in one of three instances, two of which apply to this study. One instance is the condition of limited resources (in this case, time and money) that hinder the ability to generate a random sample. A second instance is the availability of the materials being studied. Obtaining specific issues of newspapers is sometimes impossible. Smaller newspapers don't always keep well-organized archives, and the press association's copies are destroyed daily by the clipping service.

### *Newspaper Classification*

The newspapers were divided into six groups for classification. As mentioned earlier under the Assumptions section, circulation size is used as the determining factor of financial resource. The circulation classifications are taken from Davis's (1995) survey of Missouri newspapers: 1–2,500; 2,501–5,000; 5,001–10,000; 10,001–25,000; 25,001–50,000; and over 50,000.

### *Selection Method*

The selection method is called a convenience sample, meaning it is based on availability of data. Even though the selection process is not random, the possibility of bias has been considered and controlled for. Every issue of every daily newspaper available was included. I made no decisions about which newspaper or issue should be included in the population, thus eliminating any possibility of bias. Furthermore, Riffe and Fico (1998) argue:

The value of research using convenience samples should not be diminished. Science is a cumulative process. Over a period of time, consistent results from a large number of convenience samples suggest important research questions and hypothesis or even generalizations to be checked with probability samples or censuses (p. 87)

A total of 268 newspapers belong to the Missouri Press Association, 46 of which are classified as dailies. The rest are considered weekly or semi-weekly. The weekly and semi-weekly newspapers are not included in this study for two reasons. First, obtaining past copies from some smaller newspapers was not possible. Also, Rodriguez (1998) found that a surprisingly small number of weekly and semi-weekly papers published any graphics. My personal experience with small weekly papers leads me to agree with this finding. The majority of them lack the resources to produce a significant number of graphics; including them here would provide little knowledge gain, and perhaps could even be detrimental to the application of this study.

Along with the exclusion of non-daily newspapers, four dailies were also excluded from the study. This is because the Press Association didn't receive any issues of them the week I was there collecting data. These are the *St. Louis Daily Record*, the *St. Louis Countian*, the *Springfield Daily Events*, and the *Kansas City Daily Record*. All of these are legal publications focused on publicizing housing foreclosures, not traditional newspapers, and all have a circulation under 1,000.

## **Coding Procedure**

The coding procedure, variables, and operational definitions are closely based on Rodriguez's research. Any deviations were purposefully made to either improve or clarify her work.

Due to the small timeframe for data collection I did all the coding myself, but an inter-coder reliability test was run to ensure accuracy. The coding had to be done after the Missouri Press Association counted and examined the newspapers but before the clipping service came to pick them up. This usually gave me a window of about 4 to 6 hours. The coding also had to be done every day, consecutively, for a week. If any days were missed the sample's validity would have been compromised.

The unit of analysis was any infographic, either free-standing or accompanied by a story. Every page of every newspaper was reviewed. Each graphic was identified, examined, and assigned two numbers, a story and a chart ID used to categorize them. The name of the newspaper and date of publication were also noted for organizational purposes.

The first variable is the number of infographics associated with a story.

The second variable is type, a categorical variable referring to format. The possible formats are line graph (includes area chart), bar chart (includes simple, stacked, and graduated bars), pie chart, table, locator map, data maps, and diagrams. The ninth option is an "other" category to encompass less common graphical formats.

The third variable is scope. It is the geographic area an infographic refers to regarding the story's locale. The visuals and text in an infographic will reference either international, national, or local scopes. A local scope is a graphic focused on information

specific to a newspaper's coverage area, and would be of little use to anyone outside that area. An example is a map of road closures in a city. A national scope references topics that affect the entire United States. An example is graphics referencing United States politics or Supreme Court decisions. An international scope references topics that have a global reach, such as wars or energy issues.

"Topic" explains the general issue covered. It was selected by collapsing commonly occurring subjects to form a categorical variable (Rodriguez, 1998). The common topics are listed below.

Predominantly Political: Focus on government issues, including political polls and international wars

Predominantly Economic: Focus on business, stocks, finance, etc.

Predominantly Science and Technology: Includes research reports, environment, and weather news

Infrastructure and Civil Engineering: Includes building projects and repairs

Crime/Legal/Traffic Accidents: A broad category, including criminal activities, actions of the judicial branch, and most events involving first responders

Natural Disasters: Such as hurricanes and earthquakes

Recreation: Anything involving recreational or cultural activities, including references to libraries and museums

Education

Sports

Other: Topics that don't fit into any other category

The “maker” variable refers to who constructed the graphic. Staff-produced (internal) graphics are created by newspaper employees. Wire service (external) graphics are produced outside the newspaper by a news production business, such as the Associated Press. This can be determined by looking at the by-line, which would include a wire service name. Internally produced ones will have the author’s name, the newspaper’s name, or no by-line at all.

An error is considered to be one of six specific deviations from the accepted graphical format and design norms. These six deviations were taken from Rodriguez’s study, which was based predominantly on Stovall’s (1997) book, *Infographics: A journalist’s guide*.

Violations of Conventions: A mistake caused by a simple oversight. No headline, attributions, labels, axes, legends; indistinguishable shading, patterns or pictures. When the design or fill used interacts with the physiological tremor of the eye to produce the appearance of vibration and movement (Tufte); maps without “North” arrow indicator or mile marker; lack of chatter when needed to explain graphic and missing callouts explaining change illustrated in chart.

Percentage Without a Base: Failure to apply a rate when needed for an accurate comparison. An example is a bar chart comparing murders in Los Angeles with murders in Kansas City. Los Angeles will have more because it has more people.

Comparing the Non-Comparable: Comparing sets of figures that are not derived from the same base. An example is comparing dollar figures over time without adjusting for inflation.

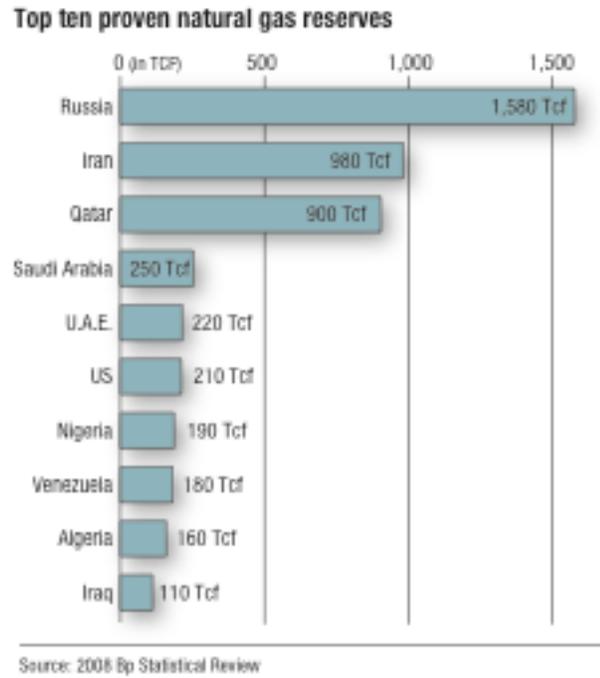
Inappropriate Graphic: Using chart designs that obscure the data. For example, using inappropriate three-dimensional bars that can confuse readers or using the wrong graphic form to present a certain type of information. The specific charts and their common purposes are bar charts, which compare and show relationships with the data; line charts, which show change over time; pie charts, which show percentages that add up to 100; and tables, which convey specific data points not directly related.

Overdressed Graphs: Superfluous ink used as decoration on a chart, and that doesn't contribute to the dissemination of information.

Non-Correspondence with Text: The story a graphic tells conflicts with its headline or chatter.

Complexity is an ordinal measure of the amount of a graphic's information. It is determined by counting the number of variables presented and is measured on a scale from 1 to 3. The following examples were created to illustrate the three levels.

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*Figure 8.* Level 1 is the most basic, presenting just one variable.

*Note.* Created by Seth Myers

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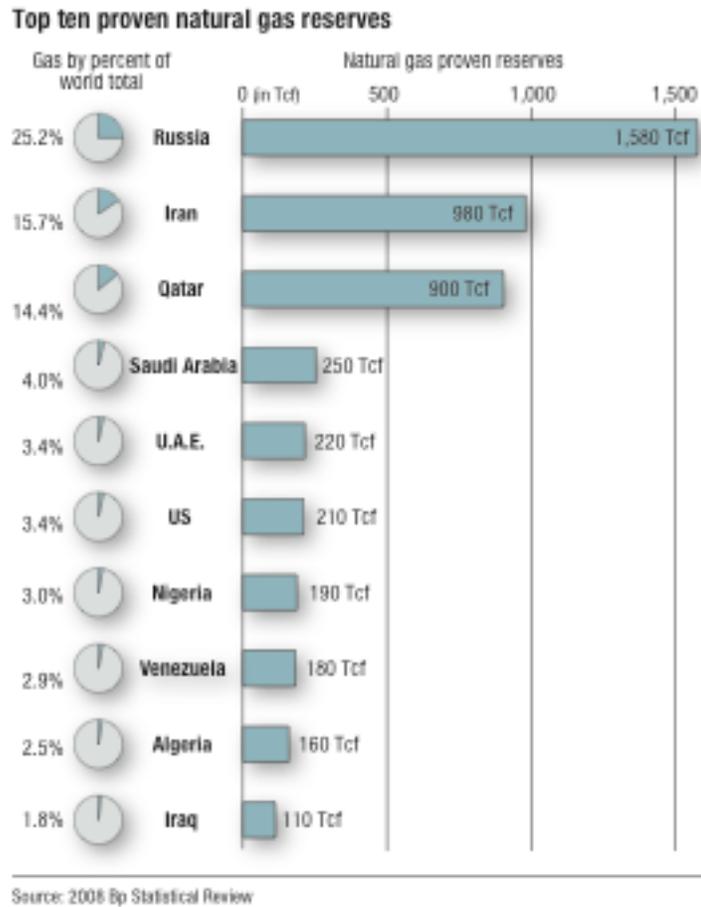
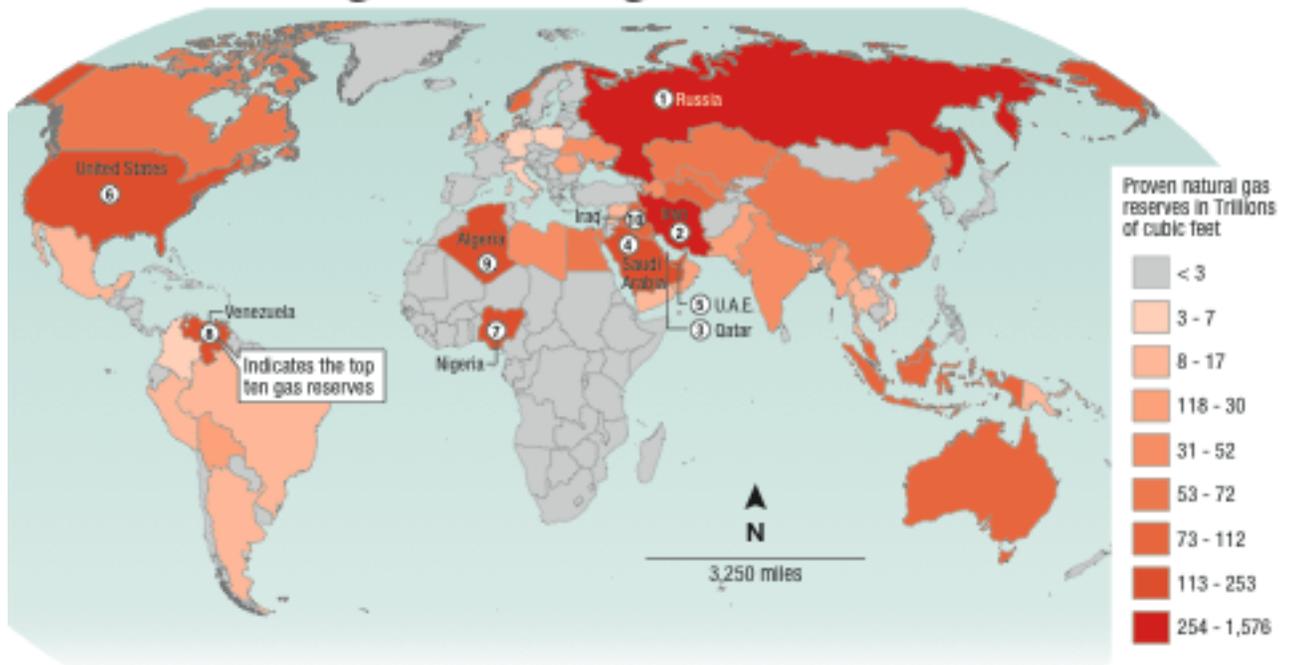


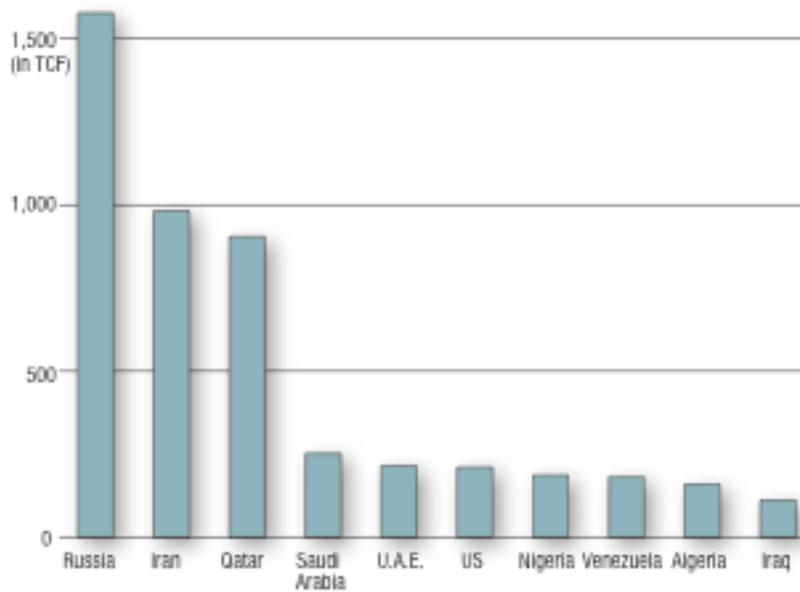
Figure 9. Level 2 is of medium complexity, presenting two to three variables.

Note. Created by Seth Myers

# The world's largest natural gas reserves



Natural gas proven reserves



Gas by percent of world total



Source: 2008 Bp Statistical Review

*Figure 10.* Graphics with four or more variables are placed in Level 3. This is the highest complexity possible. Tufte (1983) argues that excellent graphics are nearly always multivariate, and communicate complex quantitative ideas. *Note.* Created by Seth Myers

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Complexity is an important aspect to consider. A simple chart should not carry the same weight as a complex diagram because more variables mean more opportunities for mistakes.

The final variable, called “story,” distinguishes between freestanding graphics and ones accompanied by a story. A 1 indicates the graphic is accompanied by a story, and a 2 indicates it is not.

### **Inter-Coder Reliability**

Reliability is crucial to any type of scholarly study. It assures readers that the presented data can be trusted. In a content analysis, reliability is defined as the agreement among coders about how the content is categorized (Riffe & Fico, 1998).

The coder used to test the reliability of my study had little experience with visual journalism. I gave her a short lesson on infographics that touched upon the history of graphics but focused on each variable in the study and every value associated with them.

Fifteen graphics were randomly chosen for the reliability test. This is a little over the required 10% (Riffe & Fico, 1998). Percent agreement and Scott’s Pi were both reported, but Scott’s Pi was the test used to determine reliability because it corrects for chance agreement. The Scott’s Pi for each variable is presented in Table 1. The average of all variables is .799%.

Table 1.

Inter-coder Reliability Test Results

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<b>Variable</b>	<b>Type</b>	<b>Scope</b>	<b>Topic</b>	<b>Maker</b>	<b>Error</b>	<b>Complexity</b>	<b>Story</b>	<b>Average</b>
Percent Agreement	.933	.933	.733	.933	.867	.933	.933	.908
Scott's Pi	.913	.877	.677	.856	.749	.89	.63	.799

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The preferred method of gauging the test results is to reference a comparative study. Unfortunately, Rodriguez did not report a reliability test. This is the first time this study has been replicated, as well as the first time any reliability test has been attempted, and under these circumstances Riffe and Fico (1998) say a lower reliability score is acceptable. The topic and story variables are the only two below the acceptable level of 0.7%. The story variable was not used in the analysis of the hypotheses or research questions. Scott's Pi for the topic variable is just below the acceptable level. This will be noted in the discussion. Analysis using this variable should be considered groundwork for further research.

**Data Analysis**

The computer program Statistical Package for the Social Sciences was used to analyze the data. It was done by measuring the frequency of specific variables and by using cross-tabulations. The Chi-Square and Cramer's V tests were used to test for statistical significance when appropriate.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

This content analysis attempts to determine whether a newspaper's financial resources affect the number of errors in the infographics it creates. It also extends Rodriguez's research on Iowa newspapers by replicating her research with Missouri newspapers. She found that locator maps are the most common graphic type, and infographics produced in-house are just as likely to contain errors as those produced by a wire service. This chapter discloses the findings of the content analysis and compares them to Rodriguez's corresponding results. It also evaluates the results and discusses the possible implications of this study, and concludes with a review of possible limitations and suggestions for future research.

The research questions below were addressed by the research to acquire definitive answers supported by quantitative analysis. Each question has a corresponding chart to showcase the numbers and explain how the results were categorized.

#### **Findings**

A total of 143 infographics were culled from 201 issues of Missouri newspapers. Forty-two newspapers classified as dailies by the Missouri Press Association were included in the sample. Four dailies were excluded. Statistically significant differences exist among infographics printed by newspapers of various sizes; therefore, the

circulation size/financial resource plays a role in content. Figure 11 shows the classification of the newspapers and subsequent issues by circulation size. Of the Missouri dailies, papers with a circulation from 2,501–5,000 are by far the most common and produce the least number of graphics per capita.

Figure 11

Size Classification and Distribution by Newspaper and Issue

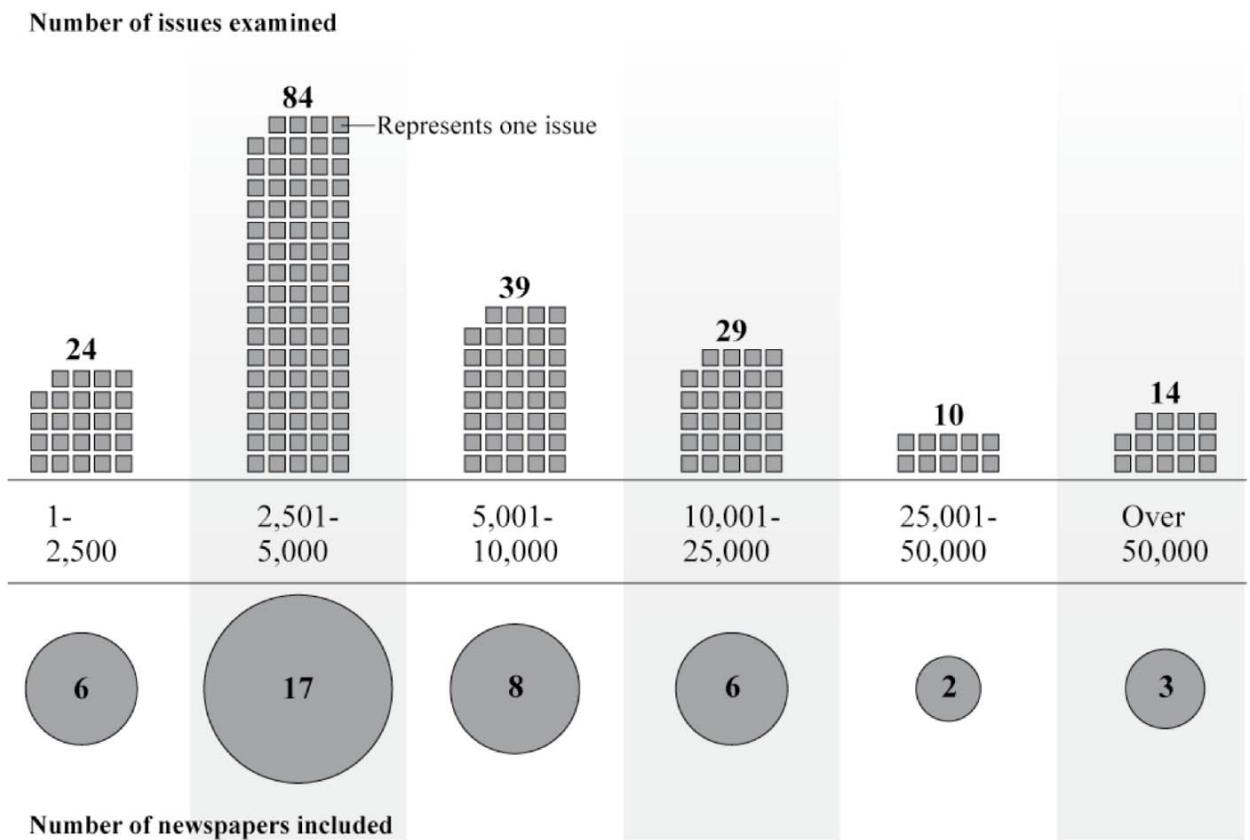


Table 2 shows the majority of graphics were printed by a handful of papers. Specifically, 80 of the 143 infographics came from just three newspapers: the *Kansas City Star*, the *St. Louis Post-Dispatch*, and the *Springfield News-Leader*. These three also happen to have the largest circulations in the state. If the *Columbia Missourian*, which is

an outlier because of its affiliation with the University of Missouri, is excluded from the study, nearly 60% of the infographics included in the study came from a mere 7% of the newspapers. This unexpected finding is an important illustration of the dramatic difference in infographic usage between large and small dailies. It suggests that a newspaper's financial resources affect more than just the number of errors, as this study suggests, but also whether infographics are used at all.

Table 2

Newspaper	City	Circulation Category/Size	Number of Issues	Number of Graphics	Percent of Total
The Boonville Daily News	Booneville	1: 2,438	5	2	1.4
The Branson Daily News	Branson	3: 9,813	5	2	1.4
Lake Sun Leader	Camdenton	2: 4,852	5	5	3.5
Southeast Missourian	Cape Girardeau	4: 16,746	5	3	2.1
The Carthage Press	Carthage	2: 3,854	5	0	0
Constitution-Tribune	Chillicothe	2: 3,128	5	0	0
Daily Democrat	Clinton	2: 3,828	5	0	0
Columbia Daily Tribune	Columbia	4: 18,600	5	8	5.6
Columbia Missourian	Columbia	3: 7,938	5	9	6.3
The Daily Statesman	Dexter	2: 4,000	5	0	0
Fulton Sun	Fulton	2: 4,069	5	2	1.4
Hannibal Courier-Post	Hannibal	3: 8,340	5	3	2.1
The Examiner	Independence	4: 13,306	5	0	0
News Tribune	Jefferson City	4: 19,483	5	7	4.9
The Joplin Globe	Joplin	5: 30,242	5	3	2.1
The Pulse Legal Publication	Kansas City	1: 655	1	0	0
The Kansas City Star	Kansas City	6: 263,209	5	31	21.7
Daily Dunklin Democrat	Kennett	2: 3,824	4	0	0
Daily Express & News	Kirksville	2: 4,680	5	0	0
The Lebanon Daily Record	Lebanon	2: 4,637	5	0	0
Macon Chronicle-Herald	Macon	2: 2,718	5	1	0.7

Newspaper	City	Circulation Category/Size	Number of Issues	Number of Graphics	Percent of Total
Marshall Democrat-News	Marshall	2: 3,220	5	0	0
Maryville Daily Forum	Maryville	2: 3,200	5	0	0
The Mexico Ledger	Mexico	3: 6,378	5	0	0
Moberly Monitor-Index	Moberly	2: 4,986	5	0	0
The Monett Times	Monett	2: 3,870	5	0	0
Neosho Daily News	Neosho	2: 3,870	5	0	0
Nevada Daily Mail	Nevada	1: 2,500	5	0	0
Daily Journal	Park Hills	3: 9,297	4	2	1.4
Daily American Republic	Poplar Bluff	4: 13,274	4	5	3.5
Daily News	Richmond	1: 2,115	4	0	0
Rolla Daily News	Rolla	2: 4,920	5	1	0.7
Sedalia Democrat	Sedalia	4: 12,747	5	6	4.2
Standard-Democrat	Sikeston	3: 8,562	5	3	2.1
News-Leader	Springfield	6: 60,763	4	25	17.5
St. Charles County Business Record	St. Charles	1: 650	5	0	0
St. Joseph News-Press	St. Joseph	5: 38,262	5	1	0.7
St, Louis Post Dispatch	St. Louis	6: 278,471	5	24	16.8
Trenton Republic-Times	Trenton	2: 3,000	5	0	0
The Daily Star-Journal	Warrensburg	3: 5,451	5	0	0
Daily Guide	Waynesville	1: 1,550	5	0	0
West Plains Daily Quill	West Plains	3: 9,200	5	0	0
<b>Total</b>			<b>201</b>	<b>143</b>	<b>100</b>

The newspapers were divided into six classifications based on circulation size; Group 1: 1–2,500; Group 2: 2,501–5,000; Group 3: 5,001–10,000; Group 4: 10,001–25,000; Group 5: 25,001–50,000; Group 6: over 50,000.

The relatively small number of graphics found in the majority of dailies provides quantitative support for Davis's (1995, p. 51) conclusion that Missouri newspapers with smaller circulations generally view graphics as being less important than larger papers do. Furthermore, Davis suggests, smaller newspapers "are limited by their experiences" with infographics. I believe this observation still holds true today. It is too costly for smaller newspapers to hire designers with the needed experience and expertise to research and create graphics. As a result, these publications simply don't have the staff to generate graphics and utilize them effectively.

Table 3 further illustrates this disparity by comparing the average number of graphics contained in each issue. Newspapers with a circulation over 50,000 ran an average of nearly six graphics per issue. In addition, Table 4 clearly shows the utter lack of graphics in any other group. Readers of daily newspapers with a circulation in the 2,501–5,000, the largest category of Missouri dailies, can expect to see about one graphic in every 10 issues. This is not even one per week, or around 36 per year.

Tables 2 and 3 also support McManus's theory that newspapers with less money use a more passive form of journalism to create content. I theorized this would be reflected in the use of wire-service graphics or by an increased number of errors. As Table 4 shows, graphics are almost entirely excluded from newspapers without the money to employ a team of trained and experienced graphic designers. The three

newspapers in the over-50,000 category are based in the three largest Missouri cities: St. Louis, Kansas City, and Springfield. Having a large reader base allowed these papers to make enough money to employ an entire graphics department. Most of the smaller papers do not have this luxury. This is not to say that none of the smaller papers have such departments, but it is a common thread in the over-50,000 category.

Table 3

Average Number of Graphics per Issue

---

Size	Graphic frequency	Issues examined	Avg. number of graphics per issue
1-2,500	2	24	<b>0.08</b>
2,501-5,000	10	84	<b>0.12</b>
5,001-10,000	27	39	<b>0.69</b>
10,001-25,000	20	29	<b>0.69</b>
25,001-50,000	4	10	<b>0.40</b>
Over 50,000	80	14	<b>5.71</b>

---

*Research Questions*

**R1:** *Do smaller newspapers publish more wire-service produced graphics than in-house produced graphics, and do larger newspapers publish more in-house produced graphics than wire-service graphics?*

The research supports R1. Table 3 shows smaller newspapers publish more wire-service graphics than in-house ones, and larger newspapers publish more in-house graphics than wire-service ones.

In Table 4, all categories ran either the same number or more of their own graphics as ones produced by other sources, except for the 10,001–25,000 group. Eighty-five percent of this group's graphics were produced outside the newspaper. This result is expected, based on McManus's (1990) economic theory. These newspapers use a passive form of reporting to maximize their profits. It is cheaper for them to use graphics produced externally than pay to salaries for their own graphics department. As a result, these papers are more likely to use the same graphics from the same wire services that tend to cover national and international news. The papers would have to produce their own graphics to cover local news. As Table 5 shows, newspapers with a circulation below 5,001 barely published any graphics at all, regardless of where they are produced.

Table 4.

Graphic Origins by Circulation Size

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Circulation	In-house	Wire-service	Other	Total
1-2,500	2	0	0	<b>2</b>
2,501-5,000	5	5	0	<b>10</b>
5,001-10,000	17	8	2	<b>27</b>
10,001-25,000	3	16	1	<b>20</b>
25,001-50,000	2	2	0	<b>4</b>
Over 50,000	68	11	1	<b>80</b>
<b>Total</b>	<b>97</b>	<b>42</b>	<b>4</b>	<b>143</b>

---

Table 5 is a condensed form of Table 4. If the categories are collapsed to two groups, small and large, the relationship between a newspaper's size and the origin of its infographics becomes apparent. Table 5 also combines the "Other" and "Wire-service" columns to create a "Not In-house" column.

Table 5

## Graphic Origins by Circulation Size – Condensed

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Circulation	In-house	Not In-house	Total
1-25,000	27	32	<b>59</b>
Over 25,001	70	14	<b>84</b>
Total	<b>97</b>	<b>46</b>	<b>143</b>

---

**R2:** *Do smaller newspapers' in-house graphics contain more errors than larger newspapers' in-house graphics?*

The research does not support R2, although a study with a larger sample size is needed for a more confident answer. Table 7 does show errors are fairly evenly distributed throughout all circulation sizes. Table 9 shows the common denominator for all circulation sizes is the locator map. Over 57 of errors were made in these types of maps.

A lack of basic map-making skills has transcended economic resources to become a problem for all newspapers. While other errors probably result from a graphic artist's lack of training and experience, mapping errors are due to something more. The biggest newspapers in the state made roughly the same number of mistakes as papers a fraction of their size. Either these mistakes are caused by other factors, like inattention to detail or a lack of time, or a large portion of Missouri newspapers don't know or don't adhere to

the basic principles of map-making, such as including a “North” arrow indicator and a mile-marker.

Table 6

In-House Errors

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Circulation	Error frequency	Graphic frequency	Percent occurrence
1-2,500	1	2	<b>50%</b>
2,501-5,000	4	5	<b>80%</b>
5,001-10,000	7	17	<b>41%</b>
10,001-25,000	1	3	<b>33%</b>
25,001-50,000	1	2	<b>50%</b>
Over 50,000	28	68	<b>41%</b>

---

Arthur Robinson, (1995), creator of the widely used Robinson Map Projection, commented in his textbook, “that a map not properly designed will be a cartographic failure” (p. 24). When journalists and graphic designers omit a map’s legend, they are failing to properly design the map. If the goal is to convey information accurately and clearly, there is no reason for this discrepancy. A map legend is similar to punctuation, and should be held in the same esteem in the newsroom. Both help the reader understand the information being communicated by reducing ambiguity in the message. Readers could possibly understand what was printed in a newspaper if it had no punctuation, but the goal is clarity and understanding. Map legends serve the same purpose as punctuation and should be included in every map printed, especially in newspapers. I suspect this

double standard may be the result of the relatively recent appearance of infographics in newspapers, but regardless of the reason, Robinson’s assertion is true for any map.

Newspaper editors need to be aware of their continued cartographic failures.

Table 7

In-House Errors – Condensed

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Circulation	Error frequency	Graphic frequency	Percent occurrence
1-5,000	5	7	71%
5,001-25,000	8	20	40%
Over 25,001	29	70	41%

---

The remaining research questions are compared with Rodriguez’s results. The purpose of this study was to replicate Rodriguez’s Iowa research on newspapers in Missouri and compare the results. In order to make the following comparisons, it was crucial this research followed Rodriguez’s as closely as possible. The only significant deviation was the addition of a variable to measure complexity. Neither of the studies counted factual mistakes as an error, i.e., fact-checking was not part of the research.

The remaining research questions are summarized as follows: economics is the most common topic for infographics; table and locator maps the most common type; violations of convention the most common error, specifically violations of mapping conventions; and newspaper staff most commonly create graphics, and are the most likely to make an error.

**R3:** *What topics are most commonly addressed in graphics?*

Table 8 shows the most commonly depicted topic is economics, at 24.5%. Almost a quarter of the graphics reviewed had to do with finance-oriented issues, but only 1.4% of graphics were pie charts. Rodriguez made a similar discovery. She also found a minimal use of pie charts (4.3%) with a high number of economic topics (26.2%). Money matters were followed by science/technology (15.4%) and sports (15.4%). After these topics, locator maps commonly accompany crime/legal (11.9%) and infrastructure (9.8%) stories. The political topic (9.8%) was depicted in the same amount as infrastructure, but it should be noted this topic category received a low intercoder reliability score.

Table 8

## Frequency of Topics

Topic	Total Graphics	Percent	Rodriguez
Predominantly political	14	9.8%	<b>21.39%</b>
Predominantly economic	35	24.5%	<b>26.2%</b>
Predominantly science and technology	22	15.4%	N/A
Infrastructure and civil engineering projects	14	9.8%	<b>13.9%</b>
Crime/legal/accidents	17	11.9%	<b>9.1%</b>
Natural disasters	1	0.7%	<b>21.39%</b>
Recreation	7	4.9%	<b>2.67%</b>
Education	5	3.5%	<b>2.67%</b>
Sports	22	15.4%	<b>2.14%</b>
Other	6	4.2%	N/A

Total 143

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*Note:* The topic categories between the two studies do not match. Rodriguez's findings are compiled for the sake of comparison. See her study for actual findings.

**R4:** *What types of graphics are used to depict these topics?*

Table 9 shows the two most popular types of graphic representations are tables (30.8%) and locator maps (27.3%), well over half of the infographics examined. A large percentage of Rodriguez's graphics were also locator maps. This common occurrence in both studies is expected because locator maps save writers from the tedious and sometimes confusing task of describing a location. Surprisingly, Rodriguez found a relatively small number of tables. Beyond this discrepancy the two studies are fairly similar.

Table 9

## Type of Information Graphics

---

Type	Frequency	Percent	Rodriguez
Line graph	13	9.1%	<b>14.44%</b>
Bar chart	16	11.2%	<b>11.76%</b>
Pie chart	2	1.4%	<b>4.28%</b>
Table	44	30.8%	<b>9.1%</b>
Locator map	39	27.3%	<b>44.38%</b>
Data/explanatory map	11	7.7%	<b>8.56%</b>
Diagram	16	11.2%	<b>7.49%</b>
Other	2	1.4%	<b>N/A</b>
Total	143	100%	<b>100%</b>

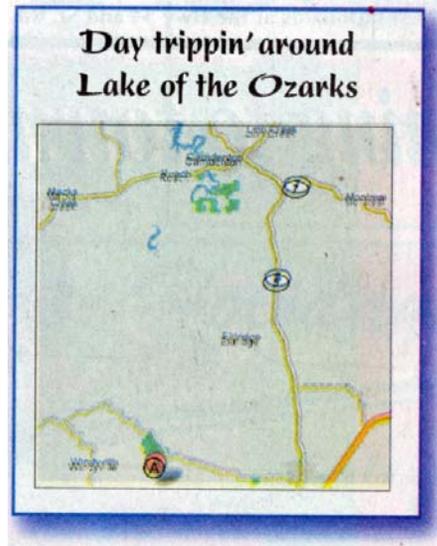
---

**R5:** *What are the most common types of errors?*

Nearly all the errors, 84%, were violations of convention. Table 10 shows that the errors vary widely from Rodriguez's findings. "Violations of convention" was also the most common error in Rodriguez's study, but it only accounted for 30% of the errors. Possible reasons for this discrepancy could be differences in either coding definitions or coding procedures. The lack of other types of errors suggests problems common in

Iowa's graphics in 1998 are not as common in Missouri today. The cause of this change is beyond this study's scope, but it may be due to the improved knowledge and education of graphic artists and editors. Error percentages and examples are shown in Figures 12 through 17.

Violations of Conventions (84.2%)



*Figure 12.* This example is from the *Lake Sun Leader*. In addition to the low print quality, the map is missing chatter to describe what is shown, as well as a legend.

*Note.* Reprinted with permission of the Lake Sun Leader, copyright 2007.

Percentage Without a Base (1.8%)

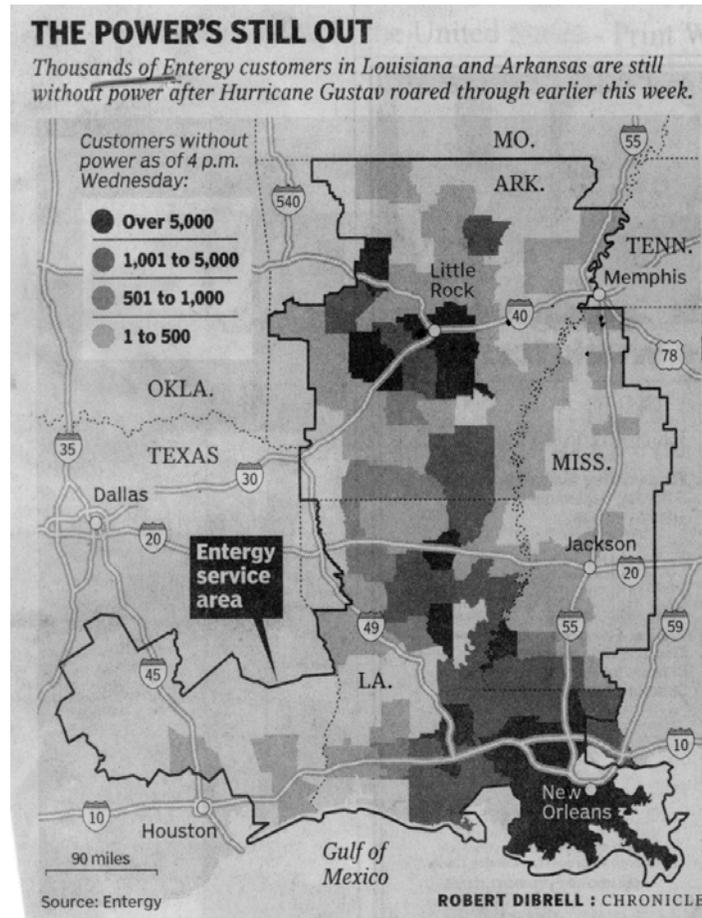


Figure 13. This is from the *Houston Chronicle*, September 4, 2008. The map shows areas of customers without power after Hurricane Gustav struck the Gulf Coast. The designer did not account for population. Thus, counties with more people have more customers without power.

Note. Reprinted with permission of the *Houston Chronicle*, copyright 2008.

Comparing the Non-Comparable (5.3%)

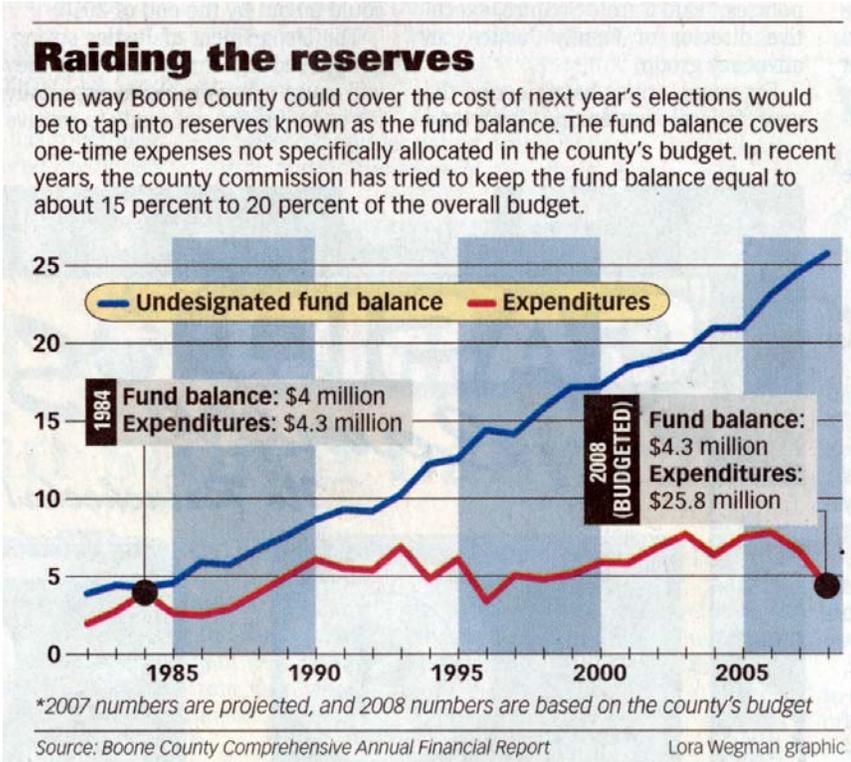
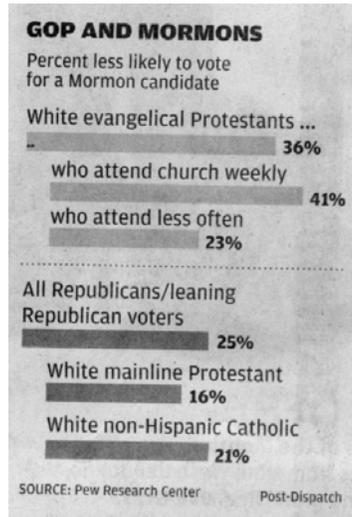


Figure 14. This is from the *Columbia Daily Tribune*. The graphic compares dollars from the early 1980s up to 2008, but does not specify whether it has adjusted for inflation.

Note. Reprinted with permission of the Columbia Tribune, copyright 2007.

Inappropriate Graphic (1.8%)

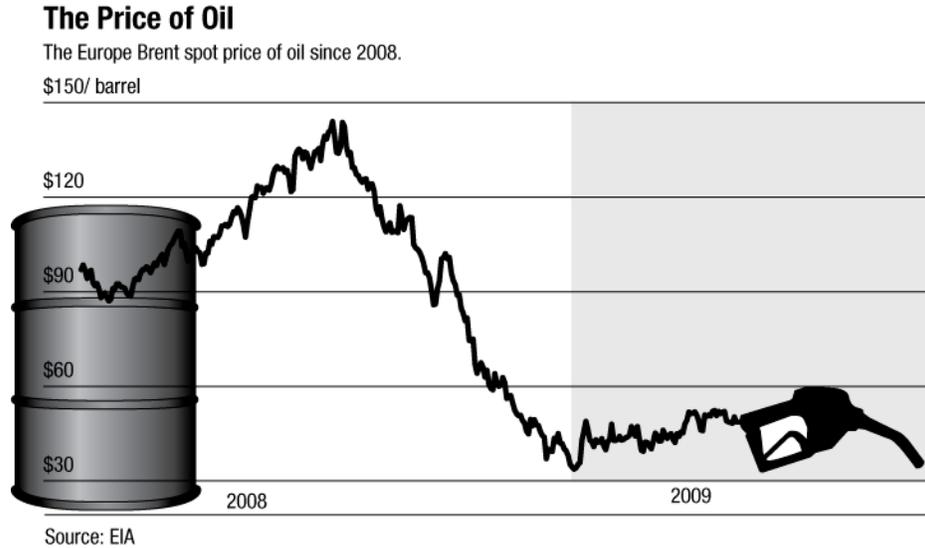


*Figure 15.* This is a chart from the *St. Louis Post-Dispatch*. The message is confusing. The bars with staggered starting points make it especially unclear.

*Note.* Reprinted with permission of the St. Louis Post-Dispatch, copyright 2007.

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## Overdressed Graphs (1.8%)



*Figure 16.* This is a classic example of an overdressed chart. It illustrates how superfluous images in a graphic can confuse the reader and distort the message.

*Note.* Created by Seth Myers



*Figure 17.* This is an example used by Rodriguez (1998, p.14). The headlines draw dramatically different conclusions from nearly identical charts.

*Note.* Reprinted here with permission.

---

Of the 48 violations of conventions errors, 31 are errors on maps, omitting either the “North” arrow indicators or mile markers. This constitutes 54% of all errors examined in the study. A map legend is a basic cartographic convention and its repeated omission suggests graphic artists in Missouri lack basic cartographic skills. This issue is compounded by the fact that, as shown on Table 9, maps are the most commonly published type of infographic.

A large part of this study’s findings are based on the rule that omitting a map legend is an error. Geographer Arthur H. Robinson agrees with this rule in his book

*Elements of Cartography:*

Maps, to be useful, are necessarily smaller than the areas mapped. Consequently, every map must state the ratio or proportion between measurements on the map to those on the earth. This ratio is called the map scale and should be the first thing a map user notices. (1995, p. 92)

It is important to note there are always exceptions to the rules. There may be unforeseeable situations that justify breaking any of these rules.

Table 10

## Frequency of Common Errors

---

Error	Frequency	Percent	<b>Rodriguez</b>
Inappropriate chart	1	1.8%	<b>14.75%</b>
Violation of convention	48	84.2%	<b>29.51%</b>
Percentage w/o base	1	1.8%	<b>21.31%</b>
Non-comparable	3	5.3%	<b>16.39%</b>
No correspondence	2	3.5%	<b>6.56%</b>
Overdressed	1	1.8%	<b>11.47%</b>
Other	1	1.8%	<b>N/A</b>
<b>Total</b>	<b>57</b>	<b>100%</b>	<b>100%</b>

---

**R6:** *Are graphics more commonly used in local, national, or international stories?*

Table 11 shows the majority of graphics are about local issues. This is expected, since the majority of graphics are created in-house. Newspapers can buy high-quality graphics about national or international incidents from wire services, but the newspaper itself must produce local content.

Table 11

Scope of Information Graphics

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Scope	Frequency	Percent	Rodriguez
International	15	10.5%	N/A
National	46	32.2%	N/A
Local	82	57.3%	N/A
Total	<b>143</b>	<b>100%</b>	N/A

---

**R7:** *What is the frequency of mistakes counted in internally versus externally produced graphics?*

Table 12 shows errors are more likely to occur in graphics produced by newspaper staff than by wire services. Rodriguez found the errors split evenly between both categories of producers, although she was surprised by this outcome. More studies are needed to determine whether one producer or the other is more likely to make a mistake. I expect in-house graphics are more likely to contain errors because presumably, wire-service providers hire highly trained graphic designers.

Table 12

Frequency of Mistakes Made by Producer

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Chart Producer	Frequency	Percent occurrence	<b>Rodriguez</b>
Newspaper Staff	41	71.9%	<b>54.1%</b>
External staff	14	24.6%	<b>45.9%</b>
Other	2	3.5%	<b>N/A</b>
<b>Total</b>	<b>57</b>	<b>100%</b>	<b>100%</b>

---

Table 13 shows a nearly exact match with Rodriguez’s findings, with almost 70% of graphics originating with the newspaper staff. This helps to solidify the proposition that overall, most graphics are produced in-house.

Table 13

## Chart Producers

Producer	Frequency	Percent	<b>Rodriguez</b>
Newspaper staff	97	67.8%	<b>67.91%</b>
External source	42	29.4%	<b>32.08%</b>
Other	4	2.8%	<b>N/A</b>
<b>Total</b>	<b>143</b>	<b>100%</b>	<b>100%</b>

**R8:** *Does complexity have an effect on a graphic's accuracy?*

Table 14 shows errors are more likely to occur in simpler graphics than in more complex ones. The simple explanation is that graphic designers do not know enough about basic mapping conventions, although locator maps are one of the most common types produced. Of the 48 errors categorized as a violation of convention, 27 were one of two elementary mapping mistakes: failing to use either a “North” arrow indicator or a mile marker. The majority of maps are simple locator maps, and these graphics with the least complexity have the most errors. This also agrees with Rodriguez’s finding: “most errors occur from simple oversight” (1998, p. 27).

Table 14

Error Frequencies by Complexity

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Complexity	Error frequency	Graphic frequency	Ratio
1 to 2 variables	39	81	48.1%
2 to 3 variables	14	39	36.9%
4 or more variables	4	23	17.4%

---

**Implications**

Foremost, Missouri editors should be aware of the dearth of infographics in most of their newspapers. Graphics and maps are powerful forms of communication and many Missouri dailies underutilize them. The effective communication of quantifiable information is a vital tool for most disciplines and industries. Without a clear, concise mode of communication, a message could easily be lost or confused. This study locates the breakdowns in newspaper infographics, providing much-needed feedback to the journalism industry. Identifying common errors is the first step towards improvement. The next step is identifying the cause of these errors.

This study’s findings agree with Rodriguez’s research, suggesting that the majority of errors printed in newspaper infographics could be easily avoided by adherence to basic mapping conventions and attention to details. Educators should be

sure to stress these skills in the classroom. Editors should pay special attention to the smaller, simpler infographics.

### **Limitations**

The sampling size and technique are obvious limitations. A random sample of newspapers over an entire year is preferable to a single week of issues.

A more complete measure of newspaper infographics would include an evaluation of aesthetics. Newspaper infographics should inform as well as catch and maintain the reader's attention. Based on Kant's (1928) notion that judgments of beauty are subjectively universal, formulating an objective measure of aesthetics for scholarly research would be difficult, if not impossible. This topic has therefore been omitted from the study.

Another limitation is the time constraint on the coding procedure. The coding process was rushed to ensure that all the newspapers were examined before the Missouri Press Association sent them to a clipping service, which could have resulted in coding errors.

Almost all the errors are classified as errors of convention, which was a catch-all category. The fact that this category contains many errors suggests problems with the variables' definitions.

The purpose of this study was to replicate Rodriguez's work as closely as possible. In retrospect I would have focused on improving her study, rather than replicating it exactly. Specifically, the study would have benefited from clearer definitions of the scope variable and the violation of convention error.

## **Future Research**

Future research should include surveys of graphic designers and design educators. Understanding their opinions on the definition of error and the overall quality of infographics, especially maps, would advance this work. Future research should also focus on understanding why the overwhelming majority of graphics printed in Missouri came from only three newspapers.

## CODE BOOK

### MISSOURI NEWSPAPER INFORMATION GRAPHICS STUDY

#### *Introduction*

The goal of this study is determine the number of errors in Missouri newspaper graphics in 2007. It examines certain aspects of individual graphics in relation to the number and type of errors found. The following five definitions are important to understanding how to analyze the data.

#### *Type*

The type variable is the format in which the information is depicted. After the coders are taught the basic characteristics of each graphic, determining its category should be clear.

#### *Scope*

The scope variable refers to the geographic area included in the graphic. The coder will read the text and examine the visual included in the graphic. Then, he/she will decide whether the information covers a local, national, or international area.

#### *Topic*

The topic variables were selected by collapsing commonly occurring subjects to form a categorical variable (Rodriguez, p. 8). The coder will read the text and visual and decide which major issue is portrayed. Rodriguez said the following topics are the ones most commonly found in her study.

### *Maker*

The maker refers to who constructed the graphic. Staff-produced (internal) refers to graphics created by employees of the newspaper or chain that owns it. Wire-service refers to any graphic produced outside the newspaper or its chain. This can be determined by looking at the by-line. Graphics from a wire service will have that company's name on the by-line. Graphics created internally will either have a name, the name of the newspaper, or no by-line at all.

### *Error*

An error is considered to be one of six specific deviations from the accepted graphical format and design. These values were created by collapsing commonly occurring errors to form categorical variables.

- 1) **Violations of conventions** – No headline, attributions, labels, axes, legends; indistinguishable shading, patterns, or pictures (when the design or fill used interacts with the physiological tremor of the eye to produce the appearance of vibration and movement); maps without “North” arrow indicator or mile marker; lack of chatter when needed to explain graphic and missing callouts explaining change illustrated in chart.
- 2) **Percentages without a base** – Failure to apply a rate when needed for an accurate comparison. An example is a bar chart comparing murders in Los Angeles with murders in Kansas City. Los Angeles will have more because it has more people.
- 3) **Comparing the non-comparable** – Comparing sets of figures that are not derived from the same base. An example is comparing dollar figures over time without adjusting for inflation.
- 4) **Inappropriate graphic** –
  - a. Using charts designs that obscure the data. An example is using inappropriate three-dimensional bars that can confuse readers.
  - b. Using the wrong graphic form to present a certain type of information. Below are the purposes of each specific kind of chart for this study. An example of an inappropriate graphic is using a table to represent percentages.
    - Bar charts are used to compare and show relationships with the data, including percentages.
    - Line charts are used to show change over time.

–Pie charts are used to show percentages that add up to 100.

–Tables are used to convey specific data points not directly related.

- 5) **Overdressed graphs** – Superfluous ink on a chart that is used as decoration and does not contribute to the dissemination of information.
- 6) **Non-correspondence with text** – The story a graphic tells conflicts with its headline or chatter.

*Complexity*

Complexity refers to one of three ordinal categories a graphic falls into, based on the amount of information presented. The categories are determined by the number of variables the graphic displays. One to two variables is considered low complexity. Three to four variables is medium complexity, and five or more is high.

Variable name	Variable label	Values	Explanation
Date	Date of publication		The publication date of each issue
Chart	Chart ID number		To categorize each chart
Number	Number of infographics in the story		The number of infographics associated with a story
Type	Format of graphic	1 = line graph (includes area chart) 2 = bar chart (includes simple, stacked, graduated bars) 3 = pie chart 4 = table 5 = locator map 6 = data map 7 = explanatory map 8 = diagram (includes passive and active diagrams) 9 = other	What type of graphic was found

Scope	Geographic scope of the topic discussed in the chart	1 = international 2 = national 3 = local	Explains what type of information the infographic covers
Topic	General category of topic or issue discussed in the chart	1 = predominantly political 2 = predominantly economic (includes local business, money matters, finance) 3 = predominantly science and technology (including the environment, research reports) 4 = infrastructure and civil engineering projects 5 = crime/legal and accidents 6 = natural disasters 7 = recreation (parks, libraries, museums) 8 = education 9 = sports 10 = other	Explains which topics are covered in the graphic
Maker	Origin or source of the chart	1 = staff-produced 2 = wire-service graphic 3 = others	Explains where the graphic was produced
Error	Spotted errors in the chart (list all that apply)	1 = inappropriate chart 2 = violations of conventions 3 = reporting percentages without a base 4 = comparing the non-comparable 5 = no text/graph correspondence 6 = overdressed graphs 7 = no error 8 = other	Explains whether the graphic contains an error and what type of error it is

Complexity	Number of variables presented in a graphic	1 = 1 variable or layer of information 2 = 2 to 3 variables or layers of information 3 = 4 or more variables or layers of information	Measures how complex a graphic is. Used to sort graphics into categories for comparison
Story	Is the graphic accompanied by a story?	1 = yes 2 = no	Explains whether the graphic is freestanding or is accompanied by a story

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